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REDISCOVERY OF *LOBELIA BOYKINII* (CAMPANULACEAE) IN DELAWARE

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ABSTRACT

Lobelia boykinii was rediscovered in a Coastal Plain seasonal pond in Sussex Co., Delaware, after a 100 year and 19 day absence. Prior to its rediscovery, it was last collected in Sussex County on 6 July 1913. Its reappearance in the state is here recognized and aspects of the species are discussed.

Lobelia boykinii Torr. & Gray ex A. DC. (Campanulaceae) is a rhizomatous perennial and obligate wetland plant that flowers in July in Delaware. A Coastal Plain endemic, *L. boykinii* is near its northern limit of distribution in Delaware and is known from eight states in the eastern USA [New Jersey, Delaware, North Carolina, South Carolina, Georgia, Florida, Alabama, and Mississippi (NatureServe 2013)]. *Lobelia boykinii* is rare to uncommon in all eight states where it occurs (NatureServe 2013), and a Global Rank of G2G3 (imperiled to vulnerable) has been applied, based on less than 100 extant occurrences (NatureServe 2013).

Historically in Delaware, *Lobelia boykinii* has only been collected four times, first in 1893 by William Canby (Tatnall 1946; DOV) and last in 1913 by Bayard Long (Tatnall 1946; PH). All four collections were from the Ellendale area of central Sussex County. Habitats were described on collection labels as "meadows" and "ditches." The area of Ellendale is a very rural part of the state and has suffered from the negative impacts of agriculture and industrial forestry practices for many decades. Weakley (2012) describes the habitat for *L. boykinii* in the Southeast as "cypress ponds and depression meadows," and the first author has observed the species growing in seasonally flooded ponds and depressions in Georgia. Though rare due to disturbance, seasonally flooded ponds and depressions still exist in the Ellendale area and were the likely habitat types prior to the first collection in 1893.

The Ellendale area historically supported other Coastal Plain species of the Southeast that grow in seasonally flooded depression wetlands, such as *Agalinis linifolia* (Nutt.) Britt., *Muhlenbergia torreyana* (Schult.) A.S. Hitchc., *Polygala cymosa* Walt., and *Tiedemannia canbyi* (J.M. Coult. & Rose) Feist & S.R. Downie [*Oxypolis canbyi* (Coult. & Rose) Fern.]. Ellendale is the type locality for *T. canbyi*, where it was first collected by William Canby in 1867 (Tatnall 1946). Interestingly, Canby made a collection of *T. canbyi* in August of 1893 (Tatnall 1946; DOV) and of *L. boykinii* in July of the same year (Tatnall 1946; DOV). The habitats for both collections were described as "meadows, Ellendale." In South Carolina, *Lobelia boykinii* occurs at 12 sites that also support *T. canbyi* (Julie Holling, pers. comm. 2013). In Georgia, *L. boykinii* is found at two sites where *T. canbyi* is also found (Rebecca Pudner, pers.comm. 2014).

Figure 1. *Lobelia boykinii* in Sussex Co., Delaware. Photo by Ron Wilson, 25 July 2013.

In late July 2013, in Sussex Co., Delaware, while conducting a population survey of *Dichanthelium hirstii* (Hirst brothers' panic grass), a globally rare species and Candidate for Federal listing, the authors were both thrilled and stunned to find *Lobelia boykinii* (Fig. 1). Thrilled because we both knew that it had not been reported for a very long time in Delaware and was perhaps extirpated from the state, and stunned because we were about 25 miles (42 kilometers) southeast of where it was historically known, at a site that has been visited annually for 29 years! Frank Hirst (1928-2009) discovered this site in 1984, a shallow, seasonally flooded depression known as a Coastal Plain seasonal pond. The flora of Coastal Plain seasonal ponds in Delaware and on the Delmarva Peninsula are strongly influenced by fluctuating groundwater levels (McAvoy & Bowman 2002). They are typically flooded in winter and spring, draw down through the summer, and are dry by late summer or fall.

When Frank discovered this site, he found *Dichanthelium hirstii*, the grass named for him and his brother Bob (1925-1963). Prior to this discovery, *D. hirstii* was only known from southern New Jersey where the brothers first discovered it in 1959 (Swallen 1961). Due to *D. hirstii's* great rarity, population counts have been done annually since it was first found in Delaware. Since 2010, site visits and monitoring were conducted once per month, from June to November. Prior to 2010, beginning in 1984, site visits were not monthly, but usually several visits were conducted each year.

Therefore, over a 29 year period botanists have been visiting this site on a regular basis and *L. boykinii* was never observed. It is certainly possible that the species was present and flowering during one of those monitoring visits and just missed, but unlikely because the entire site was always carefully searched for new plants of *D. hirstii*. In addition to *D. hirstii* and *L. boykinii,* this site also supports many other state rare plants, such as *Boltonia asteroides* (L.) L'Her. var. *glastifolia* (Hill) Fern., *Coelorachis rugosa* (Nutt.) Nash, *Eriocaulon compressum* Lam., *Hypericum denticulatum* Walt., *Rhexia aristosa* Britt., *Rhynchospora filifolia* Gray, *R. harperi* Small, *R. inundata* (Oakes) Fern., *Sabatia difformis* (L.) Druce, *Sclerolepis uniflora* (Walt.) B.S.P., and *Xyris smalliana* Nash.

Voucher specimens. **Delaware. Sussex Co.**: 14 stems, 3 with fading flowers, in 17 inches (30 cm.) of water, stems clustered in a 30 x 20 cm. patch, in sun, this collection consists of several stems that had broken away and were floating at the water surface, growing in a seasonally flooded depression southwest of the town of Bethany Beach, with *Dichanthelium hirstii*, 25 July 2013, *W.A. McAvoy 7190 & R.M. Wilson* (DOV); "Ellendale," 6 July 1913, *Bayard Long s.n.* (PH); "ditches along railroad, Ellendale," 9 July 1908, *C.S. Williamson s.n.* (PH); "ditches along railroad, Ellendale," 20 June 1909, *C.S. Willamson s.n.* (PH); "meadows, Ellendale," 24 July 1893, *William Canby s.n.* (DOV).

It is interesting to note that *Lobelia boykinii* is an associate at 5 of the 8 locations in the USA where *Dichanthelium hirstii* is either historical or extant: New Jersey — three sites, one extant, *L. boykinii* is known from two of the sites; Delaware — one extant site, *L. boykinii* present; North Carolina — two sites, one extant, *L. boykinii* is known from both sites; and Georgia — two sites, both historical, the exact locations of the Georgia collections (Harper 1900; Thorne 1947) are not known, so *L. boykinii* may or may not have been an associate. Many years before he passed away, Frank Hirst once mentioned to the second author that he thought the pond in Delaware where he found the Hirst Brothers' panic grass "looked like a good pond for *L. boykinii.*"

Lacy et al. (2001) and Royo et al. (2008) found that *Lobelia boykinii* seeds germinate in August and early September in North Carolina and then seedlings develop into rosettes, which will grow through the winter even in standing water. In April of the next season, rosettes disappear from aboveground view, to reappear later that fall. If a rosette survives its first nineteen months of life, it either flowers, or dies back to the rhizome in its second season (Lacy et al. 2001; Royo et al. 2001). Based on this life history, seeds of *L. boykinii* at the Delaware station may have germinated from a dormant seed bank in August or September of 2011 (pond dry). Rosettes that developed from seedlings would then have persisted through the winter (pond flooded), and then died back to rhizomes in April or May of 2012 (pond flooded), then reappear as rosettes again in September (pond dry). These rosettes would have lasted through the winter of 2013 (pond flooded), and then flowered in July (pond flooded). Lacey et al. (2001) cited two seed bank studies: one found no seedlings of *L. boykinii* germinating from soil cores from three sites, and another found that only freshly collected seed germinated. Lacy et al. (2001) noted that these studies suggest that seed longevity for *L. boykinii* is "short." Based on the fact that *L. boykinii* had never been observed at the Delaware location during 29 years of visitation until 2013, perhaps *L. boykinii* does seed bank and seed viability is longer than previously estimated. Additionally, Mitschunas et al. (2008) pointed out that in habitats providing irregular opportunities for seedling establishment, it may be beneficial for a species to have a long-lived seed bank in order to bridge prolonged periods without such opportunities. The flooding and draw-down cycles in the Coastal Plain seasonal ponds in Delaware are strongly influenced by local weather patterns and are therefore unpredictable, so these seasonal ponds would fit the category of a habitat that provides irregular opportunities for seedling establishment.

Lacey et al. (2001) pointed out that their observations suggest that growth of *Lobelia boykinii* is strongly influenced by standing water depth and duration. In 2012, Hurricane Sandy hit Delaware

and surrounding states on 29 October and the *L. boykinii* site in Delaware flooded with over 12 inches (30 centimeters) of water. Residual flooding from Hurricane Sandy in 2012, along with other storms in 2013, kept the pond fully flooded throughout much of the 2013 growing season. *Lobelia boykinii* in Delaware was found flowering in 17 inches of water (43 centimeters) (Fig. 1). Is flooding the mechanism that triggers flowering in *L. boykinii*? The 2012/2013 flooding of the Delaware pond was one of the deepest and longest that has been recorded during the 29 years of monitoring the site. Was *L. boykinii* dormant as an above-ground basal rosette waiting for just the right degree of flooding to flower? Conversely, a population of *L. boykinii* in New Jersey produced over 200 flowering plants on a "dry pond bottom" (David Snyder, pers. comm. 2013). Only long-term population monitoring throughout the range of the species can reveal even some of its secrets.

Lobelia boykinii is self-incompatible (Lacy et al. 2001; Royo et al. 2001) and Royo et al. (2008) found that successful fertilization of *L. boykinii* appears to be dependent on cross-pollination by insects between different genotypes within a population. According to Royo et al. (2008), small populations of *L. boykinii* have a reduced number of genotypes available for cross-pollination, which therefore limits seed production. The Delaware population of *L. boykinii* consisted of 14 stems (three stems with fading flowers) within a patch about 30 x 20 cm. in size (Fig. 1). The flowers found on three separate stems never set fruit. It is possible that this population was one genotype (clonal) and thus self-incompatible.

It will be interesting to see if *Lobelia boykinii* shows itself again in Delaware in 2014, either as a flowering plant or as a basal rosette developed from the rhizome that produced the 14 stems in 2013. According to Lacey et al. (2001), if an individual rhizome survives after flowering, it produces one to several new rosettes the following fall. The depth of flooding in the Delaware pond in 2013 was such that the pond bottom was not clear enough to tell if a rosette was present.

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